1. Introduction
Canterbury Basin is one of the southeast frontier basins in New Zealand and is under active exploration. Marine mudstones within the Cretaceous and Paleocene succession are the main seal rocks for the underlying Cretaceous reservoir units in the basin. High-quality 2D and 3D seismic data reveal the presence of extensive Paleocene and Eocene Polygonal Fault Systems (PFS) in the offshore Canterbury Basin. These extensive layer-bound normal fault systems typically develop in fine-grained (litho-pelagic) sediments during early stages of burial and compaction (Cartwright and Dewhurst, 1998; Cartwright, 2011). The presence of PFS provides information on the depositional environment in areas with limited well coverage. Timing of development of PFS in relation to the petroleum expulsion is critical for understanding fluid migration and basin prospectivity.

In this study we show the distribution of polygonal faulting in the basin, utilising the detailed geometry of the faults in the Waka 3D seismic volume. We also discuss their significance for interpreting paleo-depositional environments and lithologies, and implications for fluid migration.

2. Data and methods
Waka 3D has been used to characterise the fault geometry and displacement of the polygonally faulted intervals. This provides the basis for mapping the distribution of PFS throughout the basin using the available 2D seismic data.

3. Characterisation of the Polygonal Fault Systems (PFS)

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4. Implications on facies and depositional environment interpretation
- PFS are mainly observed in the mudstone dominated layers (e.g. Clipper-1 in Figure 7).
- All mudstone-dominated layers do not contain polygonal faults (Figures 6 and 7). Polygonal faults may be confined to mudstones dominated by clay-sized particles.

5. Implications for fluid migration
- Previous modelling suggests that expulsion from the mid Cretaceous (Clipper Formation) source rocks commenced as early as the Paleocene (Austral Pacific Energy Ltd, 2007; Leary and Mogg, 2008).
- Global examples of PFS suggest that they can develop within 100 m of the seabed in water depths of >1000 m (Gay et al., 2004).
- The presence of a pervasive network of polygonal faults in the Paleocene and Early Eocene intervals may have contributed to a higher rate of loss of petroleum generated from the mid Cretaceous source rocks.

6. Conclusions and uncertainties
- Polygonal Fault Systems (PFS) in the offshore Canterbury Basin occur in three layer bound fault tiers and are widely distributed in the Paleocene and Eocene intervals.
- Presence of PFS indicate a mudstone-dominated facies in an outer shelf-bathyal depositional environment.
- Especially during early stages of compaction, PFS in the Paleocene and lower Eocene intervals may have acted as conduits (seal bypass systems) for petroleum expelled from the mid Cretaceous source rocks.
- At present there is a lack of clear evidence of non-intrusive related fluid escape features within polygonal fault intervals and it may indicate a sealing nature of these faults. Further analysis is required to determine whether PFS negatively impact on seal integrity.

7. References